of Mte. Cantomoro, Penna, and Scaletta extend south-east, towards Varese-Ligure, to Mte. Quatese, Cavallone, Setterano, and Carignone, all at about 1,300 metres altitude, in three more or less parallel zones with intervening strata of argillaceous schist containing abundant lenticular intercalations of diabasic breccia, of which extensive agglomerations also appear on the northern flanks of Mte. Penna. The diabasic zones obviously represent original submarine lava streams flowing in the planes of the plastic sedimentary strata in which the débris became infolded and cemented to breccia.

Conclusion.

The phenomena presented by the ophiolithic and sedimentary groups of Eastern Liguria are substantially the same as those of the Triassic Voltri and the Sestri and Isoverde Eocene groups west of Genoa. Both regions afford striking evidence of intense folding, crushing, contortion, and brecciation which the sedimentary and the ophiolithic rocks of submarine eruptive origin during their contemporaneous uprise and subsequent settling experienced alike. There is no tangible evidence of these groups being transported areas, while everything points to their emergence and location in situ.[1] The effects of repeated earth-movements, including those of a seismic character, are strikingly evidenced by the frequently cataclastic condition of the Ligurian littoral from the coast to the crest of the Apennines, and the compression of the region during its uprise and settlement must have been all the greater considering that it lies in the contracted semicircular curve of the Gulf of Genoa.

III.—On the Classification of the Terebratellidæ.

By J. Allan Thomson, M.A., D.Sc., F.G.S., Director of the Dominion Museum, Wellington, New Zealand.

Introduction.

THE observations presented by Mr. J. Wilfrid Jackson (1916)[2] on my paper on "Brachiopod Morphology", published in this Magazine in 1915, are very welcome as furnishing many important details omitted by Davidson and other writers in the description of species. The error into which I fell as regards the types of folding of *Dallina* and *Dallinella* illustrates the danger of relying on figures when specimens are not available, but it was worth while making such an error when the correction of it brought forward so many useful observations on other points, particularly on the prevalence of

microscopically some of the ophiolithic rocks on the north of the Apennines: "Sopra alcune roccie serpentinose dell'Apennino Bobbiese," Boll. R. Com. geol., 1881, p. 58 et seq.; also D. Zaccagna, Relazione, 1902; ibid., 1903, p. 39.

[1] Further east towards Spezia the Mesozoic and Tertiary sedimentary strata exhibit an abnormal superposition which has always been regarded as an extensive inverted fold, but may be the effect of an overthrust. In the ophiolithic areas of Eastern Liguria, on the other hand, the Eocene sedimentary sequence is normal.

[2] References are given in the list of papers at the end of this article, and are indicated in the text by the author's name and date.

dental plates in the Dallininæ and the relationships of *Mühlfeldtia*. These observations pave the way for a further advance in the natural or genetic grouping of species and genera. At the same time, while admitting that *Dallina* is ventrally biplicate, I am not disposed to agree with Mr. Jackson that the folding is exactly comparable to the ventral biplication exhibited in some species of *Magellania*, but probably arose in a different way. I refrain from a further statement on this point, as I understand that Mr. S. S. Buckman is discussing the subject of types of folding fully in his forthcoming memoir on the Jurassic Brachiopods of Burma. In what follows I shall have again, through lack of specimens in Colonial museums, to rely on figures to some extent, and may possibly again err from this cause, and if so hope the correction will be applied as promptly and informatively as in the former case.

Primary Divisions of the Terebratellidæ.

Beecher, in 1895, recognized three subfamilies within the Terebratellidæ, distinguished by loop characters and development, viz.: the Megathyrinæ, the Dallininæ, and the Magellaninæ. In 1897 Schuchert included besides these three also the Devonian Tropidoleptinæ, but in 1913 he relegated this subfamily to the Strophomenidæ, with the other members of which it agrees more nearly in geological age, and retained in the Terebratellidæ only the three subfamilies adopted by Beecher, whose epoch-making classification has thus stood the test of time for twenty-one years.

Certain minor modifications of Beecher's statement of the order of loop development in the higher subfamilies of the Dallininæ and Magellaninæ have become necessary owing to the re-naming and closer definition of some of the genera on which he based his terms. The following table shows the former and the revised nomenclature :—

Stages of Loop Development in Terebratellids.

Dallininæ.		Magellaninæ.	
Beecher, 1895.	Revised Nomenclature.	Beecher, 1895.	Revised Nomenclature.
Platidiform.	Platidiform.	Bouchardiform Megerliniform	Premagadiniform.
Ismeniform.	Ismeniform.	Magadiform.	Magadiniform.
Mühlfeldtiform.	Frenuliniform.	Magaselliform.	Magelliform.
Terebrataliform.	Terebrataliform.	Terebratelliform.	Terebratelliform.
Dalliniform.	Dalliniform.	Magellaniform.	Magellaniform.

The reasons for an alteration of the terms applied to early stages of *Terebratella* and *Magellania* have been fully explained in former papers (Thomson, 1915, Nos. 2 and 3). The substitution of 'Frenuliniform' for 'Mühlfeldtiform' has been proposed by Jackson (1916) on the ground that *Mühlfeldtia* belongs to the Magellaninæ and not to the Dallininæ. In any case 'Frenuliniform' is the

preferable term, since Beecher had really *Frenulina sanguinolenta*[1] in mind when he spoke of *Mühlfeldtia*, for although he mentioned *M. truncata* he used in his illustrations *M. sanguinea* = *Frenulina sanguinolenta*.

The so-called 'Platidiform' stage of the loop in the Dallininæ is not strictly comparable to the brachidium of *Platidia*, as is shown below, and does not appear to be represented in the adult brachidium of any known genus, but it can hardly be doubted that a genus with such characters will one day be found.

Jackson's reasons for removing *Mühlfeldtia truncata* from the Dallininæ and placing it in the Magellaninæ are the absence of dental plates, the resemblance of one of its early loop stages to an early loop stage of *Terebratella dorsata*, and the appearance of the secondary loop before the appearance of the primary lamellæ. Deslongchamps showed clearly in 1884 that the young loop stages of *Megerlia truncata* (=*Mühlfeldtia truncata*) form a close parallel with the adult brachidia of *Kraussina* and *Megerlina*, and it is somewhat remarkable that Beecher overlooked this resemblance and did not suspect the generic distinctness of "*Mühlfeldtia truncata*" and "*Mühlfeldtia sanguinea*".

Differences between Dalliniform and Magellaniform Ontogeny.

Before discussing whether *Mühlfeldtia* may be admitted into the Magellaninæ, it is desirable to analyse the difference in loop development between that family and the Dallininæ. Beecher pointed out that in the lower genera the median septum is generally low in the Dallininæ and projecting above the loop in the Magellaninæ. In *Bouchardia*, *Magas*, and *Magadina* it almost touches the opposite valve. In the young growth stages of the higher genera this difference between the subfamilies is not so marked, for the early platidiform stages of *Macandrevia* show a high septum. It remains true, however, that a high septum persists longer in the Magellaninæ than in the Dallininæ. There is also a slight difference in the form of the septum, which is more elongate and board-like in the Magellaninæ.

In both subfamilies the secondary part of the loop appears first as a small hood[2] on the septum, with the opening upwards and forwards. In the Magellaninæ this hood is confined to the posterior, slightly lower, end of the septum, but in the Dallininæ it projects further forwards. At this stage there is an important difference, emphasized by Jackson, viz., that in the Dallininæ the primary loop is complete from the crural bases to the septum, whereas in the Magellaninæ it is imperfect. It does not appear to be yet known whether the

[1] *Anomia sanguinea*, Chemnitz, being polynomial, Gmelin's name must be used for this species as Dall has suggested. Beecher's illustrations are based on those of Deslongchamps (1884), who referred to it as *Terebratella sanguinea*. It is, of course, a different species from *Terebratella sanguinea*, Leach, which was known at that date as *Terebratella cruenta*.

[2] The earliest stage of *Terebratella dorsata* described by Fischer and Oehlert (1892), which shows the secondary loop, has a ring on the septum, but I have detected an earlier stage with a hood in *T. rubicunda* (Thomson, 1915, No. 3).

growth of the primary lamellæ in the Dallininæ commences both from the septum and the crura, as is the case in the Magellaninæ, or from the crura only. In the Magellaninæ the completion of the primary lamellæ is attained only after the hood has developed into a ring, and on its completion the Magadiniform stage is reached. In this stage the primary lamellæ and the ends of the ring are separately attached to the septum, and at a considerable vertical distance apart. In *Platidia*, as figured by Fischer & Oehlert (1891), the same is true, but in the earliest known Platidiform stages of *Macandrevia* and *Dallina* the attachment of the primary lamellæ is very oblique, and the anterior part unites with the end of the hood. A similar oblique attachment and union is not attained in *Terebratella* till a later stage, the Magelliform, when the ring has attained a considerable size and is widely open.

Some similarity exists between late Platidiform and Ismeniform stages of *Macandrevia* and *Dallina* on the one hand and early Magelliform stages of *Terebratella* on the other. In all of these the primary lamellæ are complete, and run forward obliquely up the septum to unite with a ring above. The differences are that in the Platidiform and Ismeniform stages the ring is not so large nor so widely open, while its lower ends project forwards into two divergent points, whereas in *Magella* and in Magelliform stages the lower ends are more or less rounded.

The chief difference in later stages is that in the Dallininæ lacunæ open on the lower sides of the ring and so produce a Frenuliniform stage which has no counterpart in the ontogeny of *Terebratella* or *Magellania*.

Mühlfeldtia and its Allies.

Mühlfeldtia truncata differs in its ontogeny from members of Dallininæ in that the secondary part of the loop appears as a ring before the primary lamellæ appear. Furthermore, as in the Magellaninæ the primary lamellæ grow from each end to unite in the middle. There appear, however, to be other features in which differences from the Magellaninæ exist, and some resemblance to Dalliniform ontogeny may be traced. The high board-like septum of the early stages of the Magellaninæ does not appear to exist so far as one may judge from the figures of Deslongchamps (1884) and Fischer & Oehlert (1891). Certainly in *Kraussina* and *Megerlina* the septum is quite low. The ring above the septum in the earliest known stages of *Mühlfeldtia* is different in shape and position from the ring in pre-Magadiniform and Magadiniform stages of *Terebratella*. It lies further forward on the septum, and the lower sides exhibit forward extensions not shown in the early stages of *Terebratella*. At a later stage in *M. truncata*, and in the adult brachidium of *Megerlina Lamarckiana*, small points which represent the anterior beginnings of the primary lamellæ appear, not on the septum, but on the lower outer sides of the ring, if Deslongchamps' figures may be trusted. This difference both from the Dallininæ and the Magellaninæ appears sufficiently fundamental to necessitate the recognition of a subfamily to include *Mühlfeldtia*, *Megerlina*, and *Kraussina*. Before such a step is taken,

however, it is desirable that a further study of the young stages of *Mühlfeldtia* should be made. Had Deslongchamps presented side views of the specimens he figured, all ambiguity would have been avoided.

In its further development *M. truncata* diverges greatly from the Terebratelliform ontogenetic series. Apparently what in the adult loop resembles the jugal band of a *Terebratella* is really the original bottom part of the primitive ring, little modified except in size. The anterior extensions of the ring become greatly enlarged, and with them the primary lamellæ increase in length, although remaining attached to the lower sides of the ring at their point of origin. Neither Davidson, Deslongchamps (1884), nor Fischer & Oehlert (1891) show in their figures any sign of lacunæ such as occur in *Frenulina*, but in a specimen from the Mediterranean in the Dominion Museum, Wellington, they exist as narrow slits separating for some distance the anterior extensions of the primary lamellæ from the anterior extensions of the ring.

There is another genus which by an anterior extension of the secondary part of the loop prevents some resemblance to *Mühlfeldtia*, viz. *Campages*, Hedley (1905), which occurs on the south and east coast of Australia. In the type species, *C. furcifera*, Hedley, there is also a slight development of lateral lacunæ, but these do not appear to be present in the only other known species, *C. jaffaensis* (Blochmann).[1] Through the kindness of Dr. J. C. Verco, of Adelaide, I have been able to examine a small series of the young of the latter species. In these the typical high septum of the Magadiniform and pre-Magadiniform stages of *Terebratella* is seen, and up to the Magadiniform stage there is no marked difference from the young of *Terebratella* except that the ribbon of the ring is broader and extends further forward. The later stages are not well displayed by the series, but it is evident, from the occurrence of a Magadiniform stage with widely separate attachment of the primary lamellæ and of the ring on a high septum, that *Campages* is not a close ally of *Mühlfeldtia* but an undoubted member of the Magellaninæ, with a loop representing a specialized development of the Magelliform stage.

There are two other species that should be considered in this connexion, viz. *Megerlia Willemoesi*, Davidson, and *Terebratella furculifera*, Tate. The former is a recent species obtained by the *Challenger* Expedition off Twofold Bay, New South Wales, and has a loop resembling that of an early Terebratelliform stage of *Terebratella*, except that the reflected part of the loop is attached to the septum by two descending lamellæ, thus enclosing a triangular space. In *T. furculifera*, Tate, an Australian Tertiary fossil, the same kind of connexion with the septum occurs, but the brachidium appears to be rather more advanced, and comparable to a late Terebratelliform stage. These two species occur in the same region and are thus probably related. Their loop characters are quite distinct from those

[1] Originally described by Blochmann (1910) as *Magasella jaffaensis* and ascribed to *Campages* by Hedley in 1911. Hedley also considered *Magellania Joubini*, Blochmann, a species of *Campages*, but this species appears to be correctly placed under *Magellania*.

of *Laqueus* or any other known genus, and justify the erection of a new genus.

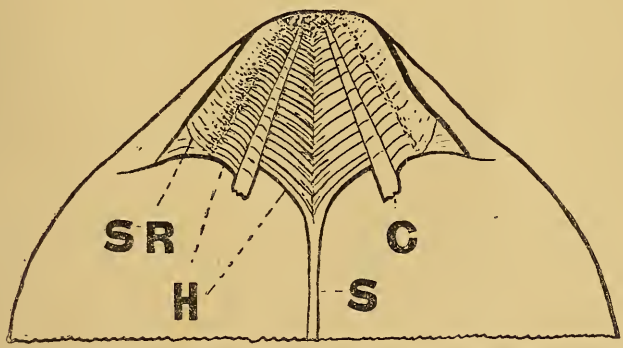
ALDINGIA, gen. nov.[1]

Genotype *Terebratella furculifera*, Tate.

Until the growth stages of *Aldingia* are known, the subfamily of the Terebratellidæ to which it belongs cannot be determined, but it appears not unlikely that it passes through a Mühlfeldtiform stage in its ontogeny, and that the descending lamellæ uniting on the septum are comparable to the sides of the primitive ring in *Mühlfeldtia*.

GENETIC STOCKS IN THE MAGELLANINÆ AND DALLININÆ.

In a former paper (1916, No. 2) I have endeavoured to show that Magellaniform loops have been produced by parallel evolution in at least three distinct stocks, each characterized by its own type of cardinalia[2] and beak characters. There are, doubtless, many other stocks equally worthy of generic recognition in the Magellaninæ, but the evidence for their separate attainment of the Magellaniform loop is not yet forthcoming.



Dallina floridana, Pourtales. Anterior-ventral view of cardinalia of dorsal valve. SR. socket ridge ; H. hinge-plates ; C. crural bases ; S. septum. There is no cardinal process. Enlarged about 2½ nat. size.

Thanks to Jackson's valuable observations we are now able to recognize similar evolutionary stocks in recent Dallininæ. Thus *Terebratalia* and *Thomsonia* are shown both to possess hinge-plates and a similar type of cardinalia differing markedly from that in *Dallina* and *Macandrevia*. As the type of the folding and the beak characters are also similar in *Thomsonia* and *Terebratalia*, these genera doubtless form one evolutionary stock.

Jackson states that *Dallina* possesses typically Magellaniform cardinalia, but it appears useful to draw a distinction. The only

[1] Named from Aldinga, South Australia, a notable locality for Tertiary Brachiopods.

[2] This term I intended as a (Latin) neuter plural, but in my former paper it was used as a singular noun, and I had not an opportunity to revise the proofs.

species to which I have access, *Dallina floridana*,[1] possesses hinge-plates excavate anteriorly, under which the septum reaches right to the umbo as in *Magellania*, but there is this difference, that in *Dallina floridana* the crural bases are not closely applied to the inner sides of the socket ridges, as is the case in *Magellania flavescens*, but run independently from the umbo, so that each hinge-plate is separable into two parts, one between the socket ridge and the crural base, the other between the crural base and the middle line over the septum. It is this distinction, so clearly marked in this species, that led me to revive the term of "socket ridge" for the "buttress" forming the inner wall of the dental sockets. In most types of cardinalia the crural bases are firmly united with the inner sides of the socket ridges and cannot be separately distinguished, although sometimes, as in *Neothyris lenticularis*, even when the two are firmly united laterally a line of demarcation can be more or less traced on the upper surface. Should *Dallina septigera* possess the same features as *D. floridana*, the type of cardinalia above described may be termed the Dalliniform type. In looking for a forerunner of *Dallina* with Terebratelliform loop, one would require as an essential a Dalliniform type of cardinalia. This may exist in *Terebratula spitzbergenensis*, Davidson, which Jackson groups with *Dallina septigera* and *D. floridana* in type of cardinalia, but these species appear to have distinct beak characters. In the terminology of Buckman (1916) *Dallina* had a mesothyrid foramen, while *Terebratula spitzbergenensis* appears to have, according to Davidson's figures, a submesothyrid foramen. More probably the forerunner of *Dallina* looked for will be found in *Terebratella Mariæ*, A. Adams, or in the Italian Pliocene form *T. septata*, Philippi.

In my previous paper (1916, No. 1) I suggested that the forerunner of *Macandrevia* with Terebratelliform loop might be looked for in *Terebratula frontalis*, Middendorff, but refrained from creating a genus for its reception because of ignorance of its hinge-characters. Jackson states that it possesses somewhat obscure dental plates much as in *Terebratalia*, and that its loop development and cardinalia suggest relationship with the Terebrataliform stage of *Macandrevia cranium*. I have now secured a specimen of this species and find some further points of agreement with *Macandrevia*, but also some differences. Jackson, in describing the pedicle collar, mentions that it is never developed in the higher long-looped forms, in which *Macandrevia* is included, but stated that in some of these "there is occasionally a thickening in the umbo around the foramen assimilating a pedicle collar, but it is fused to the shell and never free anteriorly". In *Macandrevia* such a plate is well developed in old shells, and extends as far forwards as the dental plates, with the base of which it is firmly fused, giving the appearance that the dental plates and the pedicle collar form a single structure free laterally from the walls of the shell but closely applied to the floor. I have observed this feature most clearly in a new species of *Macandrevia* from the

[1] Two specimens presented to the Dominion Museum, Wellington, by the United States Deep-sea Dredging Expedition off the Coast of Mexico, 1869.

Antarctic, but it also exists in *M. cranium*.[1] It is thus described by Dall (1895) in *M. americana*: "teeth strong, short, supported each by a strong buttress with a recess behind it, and in old specimens with a smooth deposit of callus on the surface of the valve between the two buttresses." This type of dental plates, supported by a deposit of callus on the floor of the valve, differs from that of *Hemithyris*, and may be termed the Macandrevian type. *Hemithyris* has a true but short pedicle collar, with which the deposit of callus in *Macandrevia* does not appear to be homologous. The Macandrevian type of dental plates is also found in *Terebratella frontalis*.

The beak characters of *Macandrevia* are of an unusual type. The pedicle opening consists of two parts—a rounded foramen, which is permesothyrid in position,[2] opening into an open delthyrium. In the usual course of events in Terebratellids, when the foramen has attained the mesothyrid position, the delthyrium has become closed by deltidial plates. In *Terebratula frontalis* the movement of the foramen ventralwards does not appear to have gone quite so far, but the relation to the delthyrium is the same.

The cardinalia of *Macandrevia* are also of an unusual type. The crural bases are fused on their outer sides to the socket ridges as in *Magellania*, and from their inner sides two hinge-plates, excavate anteriorly, descend obliquely to the floor of the valve, and becoming fused with this unite in the middle line of the valve. In the Antarctic species above-mentioned, from which this description is drawn, these hinge-plates do not extend forward beyond the crural processes, and there is a raised thread-like line occupying the position of the median septum. In *Macandrevia cranium*, Davidson (1886) states that there is no defined cardinal process or median septum, but that two deviating septa commence under the umbo and extend to a little more than one-fourth the length of the valve. These so-called septa are apparently anterior prolongations of hinge-plates similar to those described above. It is desirable that the ontogeny of the Macandreviform type of hinge-plates should be worked out. It bears some resemblance to that of early stages of *Terebratella rubicunda*, but it seems not impossible that it is a further development from a Magellaniform type.

In *Terebratula frontalis* a different type of cardinalia exists. There is a small median septum situated in front of the middle of the valve, and from it a raised thread-like line extends back to the cardinalia as in *Macandrevia*. The crural bases cannot be traced in the cardinalia with certainty. The crura spring from the anterior inner corners of strong socket ridges, between which there is a mass of shell substance overhanging in front and embayed nearly to the umbo. The outer edges of this overhanging mass are raised into ridges, and perhaps mark the crural bases, and between these ridges and the socket ridges there are well-marked depressions on the mass. On the back of the mass is superposed a small transverse cardinal process.

[1] It is figured, but not described, by Fischer & Oehlert (1891, pl. v, fig. 10 f.).

[2] The beak ridges are poorly defined, and it is difficult to be quite certain of their position. The foramen is certainly not of the submesothyrid type, into which most Terebratellids with lateral deltidial plates fall.

Terebratula frontalis cannot be placed in *Terebratalia* and requires a new genus for its reception, for which I propose :

DIESTOTHYRIS, gen. nov.

Genotype *Terebratula frontalis*, Middendorff.

Diestothyris presents many of the characters that are to be expected in a forerunner of *Macandrevia*, and differs only in its type of cardinalia. It may be provisionally regarded as belonging to the same stock as *Macandrevia*, although not in the direct line of descent of that genus.

The above discussion shows that by taking into consideration characters of beak, hinge-teeth, and cardinalia in addition to loop characters, much may be done to arrange the recent species of the Dallininæ into genetic stocks. The discussion is by no means exhaustive, and has not included the lower genera, for which a better knowledge of the Tertiary fossils of the Northern Hemisphere is desirable.

LIST OF PAPERS CITED.

BEECHER (C. E.). 1895. "Revision of the Families of Loop-bearing Brachiopoda" : Trans. Conn. Acad. Arts Sci., vol. ix, pp. 376–91, 395–9.

BLOCHMANN (F.). 1910. "New Brachiopods from South Australia," in Verco (J. C.), "The Brachiopods of South Australia" : Trans. Roy. Soc. S. Austral., vol. xxxiv, pp. 89–99 (ref. to pp. 92–3).

BUCKMAN (S. S.). 1916. "Terminology for Foraminal Development in Terebratuloids (Brachiopoda)" : Trans. N.Z. Inst., vol. xlviii, pp. 130–2.

DALL (W. H.). 1895. "Scientific Results of Explorations by the U.S. Fish Commission Steamer *Albatross*. No. XXXIV : Report on Mollusca and Brachiopoda dredged in Deep Water, chiefly near the Hawaiian Islands, with Illustrations of hitherto unfigured Species from Northern America" : Proc. U.S. Nat. Mus., vol. xvii, pp. 675–733 (ref. to p. 722).

DAVIDSON (T.). 1886. "A Monograph of Recent Brachiopoda," part i : Trans. Linn. Soc., ser. II, Zool., vol. iv, pt. i (ref. to p. 62).

DESLONGCHAMPS (E.). 1884. "Notes sur les modifications à apporter à la classification des Terebratulidæ" : Bull. Soc. Linne Normandie, sér. III, vol. viii, pp. 161–297 (ref. to pp. 200–11, pl. vii, figs. 1, 2, 3, 4, 9, 11).

FISCHER (P.) and OEHLERT (D. P.). 1891. *Expeditions scientifiques du Travailleur et du Talisman, etc. : Brachiopodes.* Paris.

—— 1892. "Mission scientifiques du Cap Horn (1882–3), Brachiopodes" : Bull. Soc. d'hist. nat. d'Autun, t. v, pp. 254–334.

HEDLEY (C.). 1905. "Mollusca from One Hundred and Eleven Fathoms, east of Cape Byron, New South Wales" : Rec. Austral. Mus., vol. vi, No. 2, pp. 41–54 (ref. to pp. 43–4, figs. 5, 6*a–b*).

—— 1911. "Commonwealth of Australia. Department of Trade and Customs—Fisheries : Zoological Results of the Fishing Experiments carried out by F.I.S. *Endeavour*, 1909–10," part i (ref. to p. 114, pl. xx, figs. 41, 42).

JACKSON (J. W.). 1916. "Brachiopod Morphology : Notes and Comments on Dr. J. Allan Thomson's Papers" : GEOL. MAG., Dec. VI, Vol. III, pp. 21–6.

SCHUCHERT (C.). 1897. "A Synopsis of American Fossil Brachiopoda, including Bibliography and Synonymy" : Bull. U.S. Geol. Surv., No. 87 (ref. to pp. 124–6).

—— 1913. "Brachiopoda," in Eastman (C. R.), *Text-book of Palæontology, adapted from the German of Karl A. von Zittel*, 2nd ed., vol. i (ref. to pp. 404–5).

TATE (R.). 1880. "On the Australian Tertiary Palliobranchs" : Trans. Roy. Soc. S. Austral., vol. iii, pp. 140–69 (ref. to p. 161, pl. xi, figs. 7*a–c*).

Thomson (J. A.). 1915. No. 1. "Brachiopod Morphology: Types of Folding in the Terebratulacea": Geol. Mag., Dec. VI, Vol. II, pp. 71–6.
—— 1915. No. 2. "Brachiopod Genera: The Position of Shells with Magaselliform Loops, and of Shells with Bouchardiform Beak Characters": Trans. N.Z. Inst., vol. xlvii, pp. 392–403.
—— 1915. No. 3. "Additions to the knowledge of the Recent Brachiopoda of New Zealand": Trans. N.Z. Inst., vol. xlvii, pp. 404–9.

IV.—On the Age of the Crystalline Schists in the Piedmontese and other parts of the Alpine Chain.

By Professor T. G. Bonney, Sc.D., F.R.S.

DR. PRELLER'S recent contributions to this Magazine on the geology of the Piedmontese Alps prove that (1) Italian authorities have expressed widely different opinions on this subject, and (2) some of them have maintained sundry Alpine gneisses and crystalline schists to be Palæozoic or Mesozoic (often Permian or Trias) in age. I infer from these contributions that he is well acquainted with the physical geography of this region, but fail to find in them any signs of either microscopic study or independent petrological work. As these have led me in several cases to very different results, I shall venture to put them on record as briefly as possible. In the course of thirty-five visits I have wandered over the peaks and valleys of the Alps from the southern border of the Cottians to the Salzkammergut, paying at first much more attention to physical than petrological questions. But in 1869, when beginning to lecture on geology, I found not only (as I was already aware) that my knowledge of rocks was scanty, but also that on this subject very little trust could be given to much that had been written. So I tried, as best I could, to teach myself.[1] With this intention I visited many places of petrological interest in our own country and on the Continent, forming (partly by purchase) a considerable collection of rock specimens and slices. Circumstances soon directed my attention to the gneisses and crystalline schists, and from 1872 I paid more and more attention to them in my Alpine journeys, of which this was the thirteenth. In 1885 (my twenty-first journey) I began endeavouring to obtain clearer ideas about their succession, history, and relation to the ordinary stratified rocks, by running sections, sometimes up to, sometimes across the watershed of the chain, going in that year from the Lake of Lucerne to the Lago Maggiore and returning across the Great St. Bernard. In 1887 I made two other complete sections, one from Grenoble to Pinerolo across Dauphiné, the other across the Tyrol well to the east of the Brenner Pass, and since that date, till the last and thirty-fifth in 1911, each journey has kept petrological questions well in view. On looking over a list of my geological papers I see that about thirty deal with Alpine petrology, and may add that one result of these journeys has been a collection

[1] Sorby, the "Father of Microscopic Petrography", had not published much on that subject before this date, David Forbes still less, and Samuel Allport was only beginning. The ordinary textbooks of geology were either of no value or misleading.